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- Water and Associated Costs in the
- Production of Cotton and Grain Sorghum,
- Texas High Plains, 1955

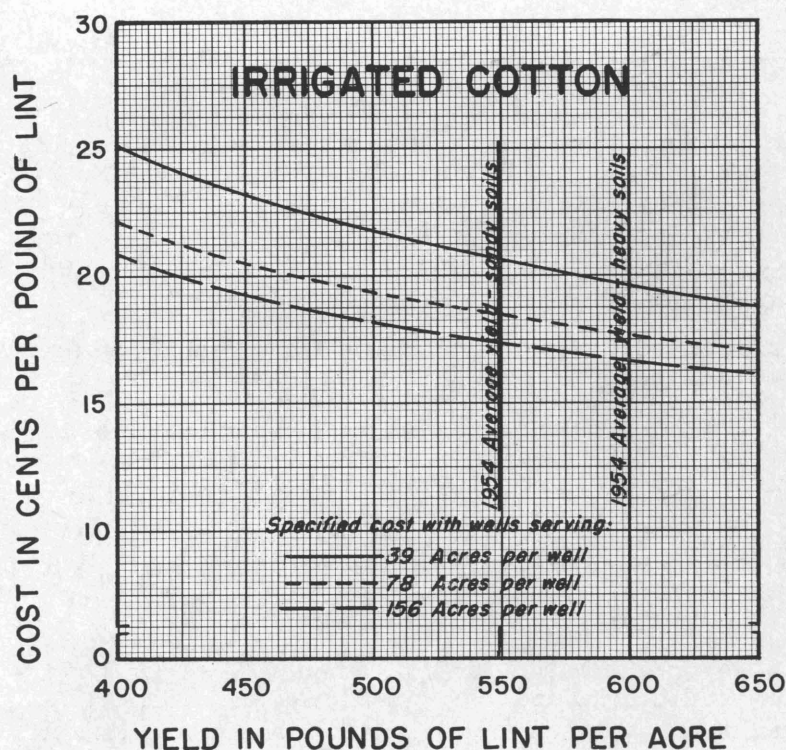


Figure 1. Specified production cost (power and machinery, labor, materials, water and harvesting cost) per pound of irrigated cotton related to yield per acre and to acres irrigated per well. Average cost on 160 and 320-acre sandy and heavy land farms.

In cooperation with the
UNITED STATES DEPARTMENT OF AGRICULTURE

SUMMARY AND CONCLUSION

Rising costs of water and machinery, along with higher rates of power, labor and water use, during the past 6 years have increased the cost of producing irrigated cotton and grain sorghum on the Texas High Plains.

The major part of the increase results from changes in the cost of water and from practices adopted to meet drouth-increased water demands with diminishing supplies of water. Based on 1955 price-cost conditions, preharvest costs of producing irrigated and dryland cotton and grain sorghum under high, medium and low water costs are:

Condition	Sandy land		Heavy land	
	Cotton	Grain sorghum	Cotton	Grain sorghum
	Dollars per acre			
Dryland—cost per acre	10.38	5.11		
Irrigated—				
High-cost water, 39 acres per well	65.00	41.00		
Medium-cost water, 78 acres per well	54.00	29.00	53.00	31.00
Low-cost water, 156 acres per well	48.00	24.00	47.00	26.00

Unit costs are affected materially by variations in yield. Specified costs—power, labor, material, water and harvesting—per pound of lint cotton vary with differences in water cost and yield level. With high-cost water, the specified cost per pound of lint ranges from 25 to 19 cents at the 400 and 650-pound-per-acre yield levels, respectively. With medium-cost water, the range is 22 to 17 cents, respectively, for yields of 400 and 650 pounds per acre. With low-cost water, the specified cost per pound is 21 to 16 cents for yields of 400 and 650 pounds per acre, respectively.

Similar unit costs on dryland cotton range from 21 to 10.5 cents per pound of lint, respectively, for yields of 75 and 325 pounds per acre.

The specified cost per hundredweight of irrigated grain sorghum also is affected by different water costs and by variations in yield. At 1955 prices, power, labor, material, water and harvesting costs per hundredweight, under the high-cost water situation, range from \$2.25 to 93 cents, respectively, for yields of 2,000 to 5,000 pounds per acre. With medium-cost water, the range is from \$1.71 to 72 cents, respectively, for yields of 2,000 and 5,000 pounds per acre. With low-cost water, the specified costs per hundredweight range from \$1.45 to 62 cents for yields of 2,000 and 5,000 pounds per acre, respectively.

Specified costs per hundredweight of dryland grain sorghum range from \$1.48 to 41 cents, respectively, for yields of 500 and 2,000 pounds per acre.

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Water and Associated Costs in the Production of Cotton and Grain Sorghum, Texas High Plains, 1955

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SHARP REDUCTIONS IN THE INCOME from irrigated farming are being experienced on the High Plains. Reduction of cotton acreage and lower prices for grain sorghum have lowered gross farm income at a time when rising farm equipment and water costs have increased production costs.

The progressive decline in water levels indicates that future water supplies will be smaller and more expensive to obtain. Because of this, the adjustment in the present rates of water will be required to prolong the economic life of the water supply. The prospect of less water and the lack of suitable alternative cash crops suggest that adjustments toward more effective use of the available water supply will involve smaller quantities of water than are now applied in the production of cotton and grain sorghum.

Information regarding production requirements and costs and the yields of individual farms from various amounts of water is a basic requirement for adjusting present practices. Information of this kind helps individual farm operators appraise the risks and possible consequences of alternative adjustments. It is basic to the formulation of policies and to the institution of water conservation programs by public agencies.

This report presents estimates of production requirements and certain per-acre and per-unit costs of producing cotton and grain sorghum on both irrigated and dryland farms of the Texas High Plains.

Land and management costs are not included in this report, but the amount available for these purposes is shown in Figures 3, 4, 7 and 8.

This is the second in a series of reports on a study concerning the most economical use of water in the agriculture of the High Plains. It is based partly on information developed in previously published studies adjusted to reflect 1955 production practices and prices.^{1 2}

CROP PRODUCTION COSTS

Except for the practices associated with the application of water, there is much similarity in the production and harvesting practices on irri-

gated and dryland crops. Crop production is highly mechanized and most farms are equipped with 4-row machinery. Cotton harvesting is the only major production practice that is not commonly mechanized. With a few exceptions, both irrigated and dryland farms are equipped with the same size and type of farm machinery. Because the practices are more intensive, irrigated farms require a greater amount of farm machinery.

Many changes were made in the practices used on irrigated farms during the shift from dryland farming. In recent years, however, most of the production practices have become more stable and standardized than they were when irrigation was first developed. Practices differ somewhat between farms on sandy soils and on heavy soils. They differ also within these groups, but most of the difference among farms on the same soil type consists mainly of differences in the amount of water applied and in minor cultural practices.

Water-use practices and investment in irrigation equipment and facilities are changing as farmers cope with the problem of supplying drought-increased water demands from a constantly diminishing water supply.³

Moisture conditions govern production practices on dryland, consequently, these practices vary widely from year to year. Practices on partly irrigated farms combine the production practices of both irrigated and dryland farms. As the acreage to be irrigated on partly irrigated farms depends to a great extent on the amount of precipitation received, practices on the irrigated portions of these farms generally are less intensive than those on wholly irrigated farms.

CONDITIONS ASSUMED FOR COST ANALYSIS

Each combination of farm resources and methods of farm operation results in a differing cost of production figure. To be meaningful, therefore, estimates of production cost must be related to a specific set of conditions that represent the widest number of farms.

Cost estimates presented in this report are based on the cost of producing cotton and grain sorghum with the production practices commonly applied on typical 160 and 320-acre sandy and heavy land wholly irrigated farms, and on a 320-acre dryland farm located on sandy land.

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Land use and crop acreages are based on 1954 conditions, when 97 percent of the farm was in cultivation, 42 percent in cotton and 58 percent in grain sorghum, or crops with similar production requirements. Machinery costs are based on the 1955 price of the amount of 4-row farm machinery commonly used to perform prevailing cultural practices. Labor costs are based on the reported 1955 wage rate paid per 10-hour day, without board. Costs of seed, insecticides, fuel and oil are based on 1955 prices. Water costs are based on the cost of water from butane-fueled pumping plants serving 39, 78 and 156 acres per plant. Harvesting costs are based on custom combine rates for grain sorghum and the cotton snapping and ginning rates in effect during 1955.

In conformity with earlier reports on this area, data for "sandy soils" pertain to production requirements and costs in Lubbock, Hockley, Lamb, Bailey and southern Parmer counties. Data for "heavy soils" reflect production requirements and costs in Crosby, Floyd, Hale, Swisher and Castro counties.

PREHARVEST PRODUCTION PRACTICES

Irrigated Cotton

A detailed account of irrigated crop production practices in 1947-49 is given in TAES Bulletin 763.¹ According to this bulletin, practices used in the preparation of seedbeds were much the same for both cotton and grain sorghum. Irrigation practices differed between crops and major soil types. For example, most of the cotton land on sandy soils was irrigated before planting, but only about 50 percent of the cotton land on heavy soils was given a preplanting irrigation.

Since 1949, changes in seedbed preparation practices, heavier rates of water application and increased insect and weed-control practices have increased labor and power requirements by 26 and 29 percent, respectively.

Flat breaking, which requires a large amount of labor and power, has become a general practice. It is not as intensively practiced on sandy soils as on heavy soils. Generally, only half of the cotton land on sandy soils is flat broken each year, but flat breaking with a disc or moldboard plow is a standard practice on heavy soils,

Cotton land on heavy soils is irrigated at least once before planting. On sandy soils, cotton usually received two preplanting irrigations. This represents an intensification of irrigation practices on both soil types.

The amount of insect control practices varies considerably, particularly in late or mid-season. Reported practices ranged from no late poisoning to five applications during 1955. Insect control is increasing in both intensity and areas affected. Hoeing also has increased in intensity.

Pump operating time increased from an average of 930 hours⁵ per season during 1947-49 to an average of 2,200 hours during 1954-55.³

Dryland Cotton

Dryland production practices depend largely on the amount of precipitation received before and after planting; thus, they vary widely from year to year. They range from a minimum of listing, planting and one or two cultivations with a light hoeing to an intensity of practices approaching that on irrigated lands. TAES Bulletin 652⁴ and Miscellaneous Publication 37² show the dryland practices during 1930-35 and 1947, respectively.

These two publications reflect practices during periods with more favorable moisture conditions than have prevailed in the past 5 years.

The dryland practices on which this study is based are somewhat less intensive than those reported for 1930-35 where only a small amount of 4-row machinery was used, and slightly more intensive than those reported for 1947 when 4-row equipment was in general use. Year-to-year variation in dryland production practices do not affect preharvest production costs materially. Most of the preharvest cost of producing a dryland crop stems from the ownership cost of machinery. Variations in the rate of production practices affect labor and fuel costs, however, since these costs are proportional to the hours of machinery use.

Dryland practices adopted for this study are those used on sandy soils. Dryland crop production practices used on heavy soils are not included, since a substantial acreage of wheat usually is planted on these farms.

Irrigated Grain Sorghum

Preharvest production practices for grain sorghum, although somewhat less intensive in their application, are similar to those for irrigated cotton.¹ As with cotton, there has been an increase in the labor and power requirements and in the amount of water used per acre in producing grain sorghum since 1949. The increase in per-acre water use is similar on both soil types, although labor and power requirements have increased more on heavy soils where flat breaking at least half of the sorghum land is a common practice. Control of weeds in grain sorghum grown on heavy soils also requires more labor and greater use of machinery.

Dryland Grain Sorghum

Preharvest production practices for dryland grain sorghum are almost identical to those used for dryland cotton. The principal difference prior to planting consists of fewer wind-erosion control measures on sorghum land, and because sorghum is commonly planted later than cotton, there is more preplanting knifing of sorghum land.

TABLE 1. PREHARVEST REQUIREMENTS FOR PRODUCING IRRIGATED AND DRYLAND COTTON AND GRAIN SORGHUM BY MAJOR SOIL TYPES, TEXAS HIGH PLAINS, 1955

Type of farm	Man-hour requirements per acre					Tractor fuel, gallons per acre ¹	Seed, pounds per acre ²	Number of insecticide applications per acre	Number of irrigations per season
	Machine	Tractor operator	Hoe	Irrigation	Total				
Sandy soils									
Irrigated cotton	4.16	4.16	5.20	2.08	11.44	16.6	48.0 ³	3.5 ⁴	3.5
Dryland cotton	1.55	1.55	3.20	—	4.75	6.2	30.0 ³	— ⁵	—
Irrigated grain sorghum	2.90	2.90	—	1.86	4.76	11.6	8.5	—	3.0
Dryland grain sorghum	1.55	1.55	—	—	1.55	6.2	6.0	—	—
Heavy soils									
Irrigated cotton	4.75	4.75	5.40	1.62	11.77	19.0	48.0 ³	3.5 ⁴	3.0
Irrigated grain sorghum	3.02	3.02	2.00	1.73	6.75	12.1	8.5	—	3.3

¹Butane.

²Seeding rates per planting: irrigated cotton, 32 lb.; dryland cotton, 20 lb.; irrigated grain sorghum, 7 lb.; dryland grain sorghum, 4 lb.

³Weight of seed before delinting.

⁴An average rate of 2 early applications and 1½ late-season applications.

⁵Depends on rainfall. With rainfall, 1 or 2 early applications; without rainfall, no application.

PREHARVEST PRODUCTION REQUIREMENTS

The labor, machine hours and materials required to conduct preharvest irrigated and dryland production practices are shown in Table 1. Water requirements, other than the number of irrigations, are not included. For this study, the amount of water is held at a constant of 17 acre-inches, gross pumpage, per acre irrigated. Because of variations in the materials the quantities of insecticides used are not reported. Instead, the more common number of insecticide applications per acre is reported, regardless of the type or quantity of materials used.

PREHARVEST PRODUCTION COSTS

Cost of the preharvest production items and practices, exclusive of water, shown in Table 1 is presented in Table 3. Water costs are presented in a later section of this report. Some of the cost items shown in Table 1 are affected by farm size. Although more equipment is required on large farms, the larger acreage involved permits a fuller use of some items of equipment and results in a lower annual ownership cost of machinery per acre.

The annual cost of machinery is governed by the amount of machinery required to equip a farm. Both the amount and age of machinery vary widely; consequently, there is a wide range in the cost of machinery on High Plains farms. Most wholly irrigated farms are equipped with the amount and kinds of machinery required before acreage-control programs reduced the cotton acreage. Before acreage control, some 70 to 80 percent of the irrigated lands in the area covered by this study commonly were planted to cotton. Irrigated farms with 100 percent of the cropland in cotton were not unusual. Present machinery inventories, therefore, are likely to be somewhat higher than actually are required with reduced cotton acreages. In this study, the amount of the investment in farm machinery is standardized. Machinery costs are based on the 1955 price of

machinery items, combine and cotton strippers excepted, commonly found on wholly irrigated cotton and grain sorghum farms, Table 2.

Data are not available to indicate the age of equipment now on farms in this general area. Since these farms have been fully mechanized for some time, it may be assumed that present machinery inventories reflect purchases over several years. Considering the fact that 1955 prices reflect a 17 to 20-percent increase in farm machinery prices since 1950, the depreciated value of present machinery inventories is probably about half that shown in Table 2.

The farm machinery investment on a 320-acre irrigated farm is nearly three times that on a similar dryland farm. Because of a heavier requirement and more intensive practices, the annual power and machinery cost for irrigated cotton is 3.5 times greater than the corresponding costs on dryland cotton. Annual power and machinery cost for irrigated grain sorghum production is double that on dryland sorghum, Table 2.

Labor costs, Table 3, are based on the prevailing 1955 wage paid for the type of labor involved—hoe or tractor operator or general

TABLE 2. TOTAL FARM MACHINERY INVESTMENT AND ANNUAL POWER AND MACHINE COST BY SIZE AND TYPE OF FARM, TEXAS HIGH PLAINS, 1955 PRICES

Size and type of farm	Total machinery investment per farm ¹	Annual power and machinery cost ²		
		Total	Cotton	Grain
		per farm	per acre ³	sorghum per acre ³
Dollars				
Sandy soils				
320-acre dryland	6,615	1224	4.88	3.22
320-acre irrigated	18,815	3500	17.82	6.44
160-acre irrigated	11,490	2177	21.62	8.34
Heavy soils				
320-acre irrigated	18,320	3585	17.08	7.39
160-acre irrigated	11,025	2133	19.78	9.19

¹Irrigation well and pumping plant costs are not included.

²Includes depreciation, interest, repairs, fuel, oil and grease.

³Prorated according to hours of use on each crop.

TABLE 3. PREHARVEST COSTS FOR LABOR, POWER AND MATERIALS, OTHER THAN WATER, REQUIRED TO PRODUCE COTTON AND GRAIN SORGHUM, TEXAS HIGH PLAINS, 1955 PRICES¹

Size and type of farm	Power and machinery cost per acre	Labor costs per acre			Seed ² cost per acre	Insecticide ³ cost per acre	Total Specified cost per acre ⁴
		Machine operation	Hoeing	Irrigation labor			
Dollars							
320-acre farm—sandy soils							
Dryland cotton	4.88	1.47	2.08	—	3.55	1.95	10.38
Irrigated cotton	17.82	3.95	3.38	1.98	9.31	3.12	35.00
Dryland grain sorghum	3.22	1.47	—	—	1.47	.42	5.11
Irrigated grain sorghum	6.64	2.75	—	1.77	4.52	.60	11.76
160-acre farm—sandy soils							
Irrigated cotton	21.62	3.95	3.38	1.98	9.31	3.12	38.80
Irrigated grain sorghum	8.34	2.75	—	1.77	4.52	.60	13.46
320-acre farm—heavy soils							
Irrigated cotton	17.08	4.51	3.51	1.54	9.56	3.12	34.51
Irrigated grain sorghum	7.39	2.87	1.30	1.64	5.81	.60	13.80
160-acre farm—heavy soils							
Irrigated cotton	19.78	4.51	3.51	1.54	9.56	3.12	37.21
Irrigated grain sorghum	9.19	2.87	1.30	1.64	5.81	.60	15.60

¹Based on requirements presented in Table 1.

²Seed cost—delinted and treated cottonseed at 6.5 cents per pound; grain sorghum seed at 7 cents per pound.

³Material cost of 50 cents per acre for early application, \$2.50 per acre custom rate for late application. Machine labor and fuel costs of early application included in machine and machine operator costs, see footnote 4, Table 1.

⁴Includes cost of machinery, fuel, oil, grease repair, labor, seed and insecticides.

farmhand. Most tractor operation and irrigation labor usually is performed by the farm operator. Hoe labor on irrigated farms commonly is hired since it is needed at a time other operations require the farm operator's attention.

Seed and insecticide costs in Table 3 are based on 1955 prices for the quantities given in Table 1.

Water costs are governed by the investment in a pumping plant, size and type of power unit, fuel type and cost, mechanical condition of pumping equipment, pumping lift, rate of well yield and total seasonal pumpage.

As this suggests, water costs differ considerably between wells, depending on how the factors listed combine at a particular well. High-yielding wells produce water at a lower cost per unit than low-yielding wells, and less labor is required to apply a given amount of water when larger irrigation heads are available. Well yield affects water costs significantly regardless of how other conditions combine at a particular pumping plant.

Although management practices provide some leeway for differences in the acreage that can

be irrigated with a given head of water (g.p.m.), the acreage irrigated from a particular well is an indication of the yield of that well. Thus, declines in well yield are reflected by the reduction in the acreage irrigated per well. The acreage irrigated per well declined 26 percent from 1950 to 1954. Water costs are influenced materially by the acres irrigated per well, which is in turn related definitely to well yields. Consequently, continued declines in water level and accompanying decreases in well yield can be expected to lead to higher water costs.

To appraise the effects of current and prospective changes in water supply, water costs are developed for typical high, medium and low-cost water supply situations found in a field survey conducted in 1955. Water costs are based on the cost of providing water with butane-fueled pumping plants serving 39, 78 and 156 acres per well, Table 4. Both the irrigation head and the seasonal amount of water pumped for cotton and grain sorghum are held constant on both heavy and sandy soils. Other conditions include 2,200 hours of pump operating time per season with gross pumpage equivalent to 17 acre-inches of water per acre.

Reasons for the higher costs of water from plants irrigating small acreages are apparent from Table 4. The per-acre investment in well and pumping equipment is \$97, \$57 and \$39 for plants serving 39, 78 and 156 acres, respectively. Since overhead costs are proportional to the investment, the per-acre overhead costs on a well serving 39 acres is 2.5 times larger than on the plant that serves 156 acres. Operating costs per acre also are 2.5 times greater on the plant serving 39 acres than they are on the plant that serves 156 acres.

Cost estimates presented in Table 3, plus the water costs shown in Table 4, equal the total preharvest cost of machinery, labor, fuel, seed,

TABLE 4. ESTIMATED IRRIGATION WATER COSTS PER ACRE, BUTANE-FUELED PUMPING PLANTS, TEXAS HIGH PLAINS, 1955 PRICE BASE

Acres irrigated, per well	Cost per plant ¹	Well yield in g.p.m. ²	Water cost per acre		
			Operating ³	Overhead ⁴	Total
39	\$3,770	135	\$16.00	\$12.10	\$28.10
78	4,500	270	9.50	7.25	16.75
156	6,040	540	6.40	4.85	11.25

¹Based on new cost of comparable plants as determined by field surveys during June 1955.

²G.p.m. required to provide gross pumpage of 17 acre-inches per acre during a 2,200-hour pumping season.

³Includes expenditures for fuel, oil, grease and repairs.

⁴Based on an allowance of 12.5 percent of initial investment to cover depreciation, interest, taxes and risk or insurance.

insecticides and water used to produce cotton and grain sorghum. Preharvest costs of cotton and grain sorghum production are related in Table 5 to the various combinations of acres irrigated per well, soil type and farm size.

Preharvest Production Cost Comparison

Preharvest production costs by the component groups (labor, power, materials and water) are shown in Table 5. Although production practices and requirements differ between heavy and sandy soils, these differences tend to cancel out and where water costs are comparable, there is no significant difference between the per-acre preharvest costs of producing irrigated cotton on sandy and heavy soils. Preharvest production costs for irrigated grain sorghum are approximately \$2 per acre higher on heavy soils than on sandy soils. Preharvest production costs for cotton are \$3.80 and \$2.70 per acre lower on 320-acre sandy and heavy land farms than on 160-acre sandy and heavy land farms, respectively. These per-acre differences are lower with grain sorghum. Preharvest costs on grain sorghum are \$1.70 and \$1.80 per acre lower on 320-acre sandy and heavy land farms, respectively.

To facilitate a comparison, preharvest costs of producing dryland cotton and grain sorghum are repeated under each of the three water-cost situations in Table 5. On 320-acre farms, the preharvest costs per acre for irrigated cotton are 4.5 to 6 times greater than similar costs on dryland cotton, and the preharvest costs of irrigated grain sorghum is about 5 to almost 8 times greater than equivalent dryland costs, depending on water costs. For 160-acre farms, the difference between dryland and irrigated preharvest production costs is somewhat greater than those on 320-acre farms, particularly for cotton.

HARVESTING AND ASSOCIATED COSTS

A high percentage of dryland cotton is machine-stripped, and a high percentage of irrigated cotton is hand-snapped once or twice, then the harvest is completed with a stripper.

Differences between hand-snapping and machine-stripping costs per hundred-weight of seed cotton affect the harvesting cost per unit. Associated costs, particularly ginning costs, also are affected by the method of harvest. Harvesting and ginning costs are based on the hundred-weight of seed cotton; consequently, they are not affected particularly by the yield per acre. The yield is likely to influence the proportion of the crop that is hand-snapped, and to that extent it will affect unit costs.

For this study, harvesting costs are based on 80 percent hand-snapping and 20 percent machine-stripping of irrigated cotton, and 20 percent hand-snapping and 80 percent machine-stripping of dryland cotton. A hand-snapping rate of \$1.75 and a machine-stripping rate of 75 cents per hundredweight of seed cotton delivered to the gin were used to compute harvesting costs. Ginning costs are based on a rate of 50 cents per hundredweight for a seasonal average of 1,900 pounds of hand-snapped and 2,400 pounds of machine-stripped seed cotton per 500-pound bale of lint. Associated costs include a charge of \$3.50 per bale for bagging and ties and 50 cents per bale for hauling to the compress.

Harvesting and associated costs, at these rates, average \$44.20 per bale for irrigated cotton and \$36.55 per bale for dryland cotton, or 8.84 and 7.31 cents, respectively, per pound of lint. The per-acre cost of harvesting cotton, therefore, is determined by the yield multiplied by the appropriate unit cost.

TABLE 5. PREHARVEST LABOR, POWER, MATERIAL AND WATER COSTS RELATED TO ACRES IRRIGATED PER WELL, FARM SIZE AND MAJOR LAND TYPES, TEXAS HIGH PLAINS, 1955 PRICES

Cost item	Size and type of farm									
	320-acre dryland		320-acre irrigated				160-acre irrigated			
	Sandy land		Sandy land		Heavy land		Sandy land		Heavy land	
	Cotton	Grain sorghum	Cotton	Grain sorghum	Cotton	Grain sorghum	Cotton	Grain sorghum	Cotton	Grain sorghum
Dollars per acre										
Wells serving 39 acres										
Labor	3.55	1.47	9.31	4.52	1	1	9.31	4.52	1	1
Power & machinery	4.88	3.22	17.82	6.64	1	1	21.62	8.34	1	1
Materials & supplies	1.95	.42	7.87	.60	1	1	7.87	.60	1	1
Water	0	0	28.10	28.10	1	1	28.10	28.10	1	1
Total	10.38	5.11	63.10	39.86	1	1	66.90	41.56	1	1
Wells serving 78 acres										
Labor	3.55	1.47	9.31	4.52	9.56	5.81	9.31	4.52	9.56	5.81
Power & machinery	4.88	3.22	17.82	6.64	17.08	7.39	21.62	8.34	19.78	9.19
Materials & supplies	1.95	.42	7.87	.60	7.87	.60	7.87	.60	7.87	.60
Water	0	0	16.75	16.75	16.75	16.75	16.75	16.75	16.75	16.75
Total	10.38	5.11	51.75	28.51	51.26	30.55	55.55	30.21	53.96	32.25
Wells serving 156 acres										
Labor	3.55	1.47	9.31	4.52	9.56	5.81	9.31	4.52	9.56	5.81
Power & machinery	4.88	3.22	17.82	6.64	17.08	7.39	21.62	8.34	19.78	9.19
Materials & supplies	1.95	.42	7.87	.60	7.87	.60	7.87	.60	7.87	.60
Water	0	0	11.25	11.25	11.25	11.25	11.25	11.25	11.25	11.25
Total	10.38	5.11	46.25	23.01	45.76	25.05	50.05	24.71	48.46	26.85

Situation not typical on heavy land farms.

Cotton quality considerations are not included in this analysis. Previous studies have indicated no significant difference in quality between hand-snapped and machine-stripped cotton, provided the cotton is harvested under comparable conditions.⁶

Grain sorghum is harvested by combines. The most common custom combine rate during 1955 was \$3 per acre for irrigated and \$2 per acre for dryland grain sorghum, regardless of the yield per acre. In this study, grain sorghum combining costs are based on the 1955 custom harvesting rate. The only variable cost involved in harvesting grain sorghum is the cost of hauling from the combine to the elevator. The hauling charge is 5 to 10 cents per hundredweight, depending on the distance to market. In this analysis, the cost of hauling is based on a charge of 6 cents per hundredweight. As the variable cost is only 6 cents per hundredweight, harvesting costs per acre for grain sorghum are not affected materially by a variation in yield.

UNIT PRODUCTION COST

Generally, the higher the yield, the lower the unit cost. Preharvest labor, power, material and water costs shown in Table 5 are not affected particularly by variations in yields. Although these preharvest costs are somewhat fixed, a higher yield distributes them over more units. The same principle applies to harvesting costs for grain sorghum, which are based on a flat charge per acre except for the small hauling cost. With cotton harvesting and associated costs, both per-acre and per-unit costs vary directly with yield. Thus, the unit cost of producing either cotton or grain sorghum is governed largely by the yield per acre.

Cotton

The total specified costs of production per acre and per unit for irrigated and dryland cotton under the conditions of farm size and water supply situations studied are shown in Table 6. Similar data for grain sorghum are shown in Table 7. Yields listed in Tables 6 and 7 and Figures 1 to 8 cover the range in yield that may be expected from the intensity of practices and water use on which this study is based. Variations in the time and amount of rainfall during the growing season affect yields enough to account for the range in yield shown.

Figures 1 to 8 show that irrigation raises the per-acre and the unit production costs for both cotton and grain sorghum. The total specified production cost per pound on irrigated cotton, under the 156-acres-per-well water cost, ranges from 21 cents at 400 pounds per acre to 16.25 cents at the 650-pound yield rate, Figure 1. Under the more expensive 39-acres-per-well water cost, the total specified production cost per pound ranges from about 25 to 19 cents at the 400 and 650-yield levels, respectively. Total specified costs per pound for dryland cotton range from 21.5 cents at 75 pounds per acre to 10.5 cents at 325 pounds per acre.

Increases in yield cause a sharp drop in the unit cost of producing dryland cotton, but with irrigated cotton the declines are moderate. This is shown by the slope of the curves in Figures 1 and 2. A 250-pound increase in the yield of dryland cotton reduces the unit cost from 21.5 to 10.5 cents per pound. A similar increase in the yield of irrigated cotton reduces unit costs by 4.6, 5.2, and 6.3 cents per pound, where wells serve 156, 78 and 39 acres, respectively.

TABLE 6. TOTAL LABOR, POWER, MATERIAL, WATER AND HARVESTING COST, PER ACRE AND PER POUND, OF PRODUCING IRRIGATED AND DRYLAND COTTON, BY MAJOR SOIL TYPES AND SIZE OF FARM, TEXAS HIGH PLAINS, 1955 PRICES

Type and size of farm	Yield in pounds of lint per acre											
	400		450		500		550		600		650	
	Cost per acre, \$	Cost per lb., c	Cost per acre, \$	Cost per lb., c	Cost per acre, \$	Cost per lb., c	Cost per acre, \$	Cost per lb., c	Cost per acre, \$	Cost per lb., c	Cost per acre, \$	Cost per lb., c
Irrigated farm												
With wells serving 39 acres												
160-acre sandy land farm	102.26	25.56	106.68	23.70	111.10	22.22	115.52	21.00	119.94	19.99	124.36	19.13
320-acre sandy land farm	98.46	24.61	102.88	22.86	107.30	21.46	111.72	20.31	116.14	19.35	120.56	18.54
With wells serving 78 acres												
160-acre sandy land farm	90.91	22.72	95.33	21.22	99.75	19.95	104.17	18.94	108.59	18.09	113.01	17.38
160-acre heavy land farm	89.32	22.31	93.74	20.83	98.16	19.63	102.58	18.65	107.00	17.83	111.42	17.14
320-acre sandy land farm	87.11	21.77	91.53	20.34	95.95	19.19	100.37	18.24	104.79	17.46	109.21	16.80
320-acre heavy land farm	87.18	21.79	91.60	20.35	96.02	19.19	100.44	18.26	104.84	17.47	109.24	16.80
With wells serving 156 acres												
160-acre sandy land farm	85.41	21.35	89.83	19.96	94.25	18.85	98.67	17.94	103.09	17.18	107.51	16.54
160-acre heavy land farm	83.82	20.93	88.24	19.60	92.66	18.53	97.08	17.65	101.50	16.91	105.92	16.29
320-acre sandy land farm	81.61	20.40	86.03	19.11	90.45	18.09	94.87	17.24	99.29	16.54	103.71	15.95
320-acre heavy land farm	81.68	20.42	86.10	19.13	90.52	18.10	94.94	17.26	99.36	16.56	103.78	15.96
Type and size of farm	Yield in pounds of lint per acre											
	75		125		175		225		275		325	
	Cost per acre, \$	Cost per lb., c	Cost per acre, \$	Cost per lb., c	Cost per acre, \$	Cost per lb., c	Cost per acre, \$	Cost per lb., c	Cost per acre, \$	Cost per lb., c	Cost per acre, \$	Cost per lb., c
Dryland farm												
320-acre sandy land farm	15.86	21.14	19.51	15.60	23.16	13.23	26.81	11.91	30.46	11.07	34.14	10.50

TABLE 7. TOTAL LABOR, POWER, MATERIAL, WATER AND HARVESTING COST, PER ACRE AND PER HUNDREDWEIGHT, OF PRODUCING IRRIGATED AND DRYLAND GRAIN SORGHUM BY MAJOR SOIL TYPES AND SIZE OF FARM, TEXAS HIGH PLAINS, 1955 PRICES

Type and size of farm	Yield in pounds per acre													
	2000		2500		3000		3500		4000		4500		5000	
	Cost per acre	Cost per cwt.	Cost per acre	Cost per cwt.	Cost per acre	Cost per cwt.	Cost per acre	Cost per cwt.	Cost per acre	Cost per cwt.	Cost per acre	Cost per cwt.	Cost per acre	Cost per cwt.
Dollars														
Irrigated farms														
With wells serving 39 acres														
160-acre sandy land farm	45.76	2.29	46.06	1.84	46.36	1.54	46.66	1.33	46.96	1.17	47.26	1.05	47.56	.95
320-acre sandy land farm	44.06	2.20	44.36	1.77	44.66	1.49	44.96	1.28	45.26	1.13	45.56	1.01	45.86	.92
With wells serving 78 acres														
160-acre sandy land farm	34.41	1.72	34.71	1.39	35.01	1.17	35.31	1.01	35.61	.89	35.91	.80	36.21	.72
160-acre heavy land farm	35.35	1.77	35.65	1.43	35.95	1.20	36.25	1.03	36.55	.91	36.85	.82	37.15	.74
320-acre sandy land farm	32.71	1.63	33.01	1.32	33.31	1.11	33.61	.96	33.91	.85	34.21	.76	34.51	.69
320-acre heavy land farm	34.75	1.73	35.05	1.40	35.35	1.18	35.65	1.02	36.15	.90	36.45	.81	36.75	.73
With wells serving 156 acres														
160-acre sandy land farm	28.91	1.44	29.21	1.17	29.51	.98	29.81	.85	30.11	.75	30.41	.67	30.71	.61
160-acre heavy land farm	31.05	1.55	31.35	1.25	31.65	1.05	31.95	.91	32.25	.81	32.55	.72	32.85	.66
320-acre sandy land farm	27.21	1.36	27.51	1.10	27.81	.93	28.11	.80	28.41	.71	28.71	.64	29.01	.58
320-acre heavy land farm	29.25	1.46	29.55	1.18	29.85	.99	30.15	.86	30.45	.76	30.75	.68	31.05	.62
Dryland farm														
320-acre sandy land farm	7.41	1.48	7.56	1.01	7.71	.77	7.86	.63	8.01	.53	8.16	.47	8.31	.41

Although irrigation increased both the per-acre and per-unit costs of cotton production, the higher yield obtained provides a larger return, as shown in Figures 3 and 5. For example, although the unit production costs of dryland and irrigated cotton at the cheapest water rate (156 acres per well) are comparable at the 75-pound dryland and 400-pound irrigated yield levels, the gross value of the 75-pound dryland lint and seed crop is \$22.60 per acre, while the 400-pound irrigated crop grosses \$128.60. The net return to land and management from dryland cotton at the 75-pound yield level is only \$6.74 per acre, while the comparable return from the 400-pound-per-acre irrigated cotton is \$43.19.

The spread between the "total specified cost per acre" and the "per-acre value of production" lines on Figures 3 and 4 indicates the net amount available for land and management per acre from dryland and irrigated cotton production.

Grain Sorghum

Figures 5 to 8 present the specified cost per acre and per unit of producing irrigated and dryland grain sorghum. The unit cost of producing dryland grain sorghum at 500 pounds per acre, Figure 6, is approximately the same as the unit cost of a 2,000-pound per acre irrigated crop grown with the cheapest water, Figure 5. With more expensive water, the unit costs of irrigated grain sorghum production are 55 to 85 cents greater per hundredweight than dryland costs. A dryland yield of 750 pounds per acre can be produced at a cost of \$1 per hundredweight, land and management costs excluded, whereas with the cheapest water, an irrigated crop must yield

at least 2,900 pounds per acre to be produced at a similar cost.

Because the value of grain sorghum is low compared with the increased production costs for an irrigated crop, the returns from irrigated grain sorghum are considerably lower than those from irrigated cotton. At 1955 prices, a grain sorghum yield of 5,000 pounds per acre was required to provide a net return equivalent to that of a 400-pound-per-acre irrigated cotton yield.

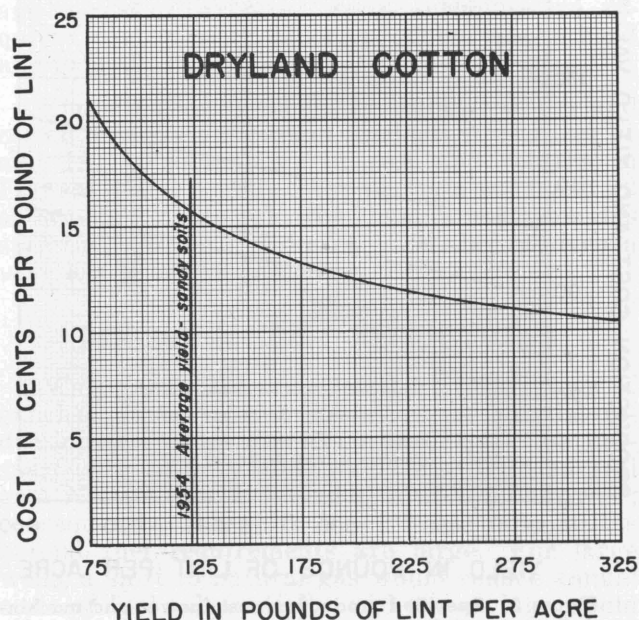


Figure 2. Specified production cost (power and machinery, materials and harvesting cost) per pound of dryland cotton related to yield per acre.

TABLE 8. TENANT'S PREHARVEST COST FOR LABOR, POWER, WATER AND OTHER MATERIALS REQUIRED TO PRODUCE IRRIGATED AND DRYLAND COTTON AND GRAIN SORGHUM BY MAJOR SOIL TYPES AND SIZE OF FARM RELATED TO ACRES IRRIGATED PER WELL, TEXAS HIGH PLAINS, 1955 PRICES

Size and type of farm	Preharvest costs per acre (exclusive of water cost) ¹		Preharvest costs per acre including water costs at ²					
			39 acres per well		78 acres per well		156 acres per well	
	Cotton	Grain sorghum	Cotton	Grain sorghum	Cotton	Grain sorghum	Cotton	Grain sorghum
Dollars per acre								
320-acre farm—sandy land								
Dryland crops	10.38	5.11						
Irrigated crops	35.00	11.76	53.56	30.32	46.04	22.80	42.72	19.48
160-acre farm—sandy land								
Irrigated crops	38.80	13.46	57.36	32.02	49.84	24.50	46.52	21.18
320-acre farm—heavy land								
Irrigated crops	34.51	13.80	3	3	45.55	24.84	42.23	21.52
160-acre farm—heavy land								
Irrigated crops	37.21	15.60	3	3	48.25	26.64	44.93	23.32

¹Entries from last column, Table 3.
²Water cost based on typical rental agreement: landlord furnishes and maintains well and pump; tenant provides engine, fuel tank and oil, fuel and engine repair costs.
³Few farms in this category.

The spread between the "total specified cost per acre" and "value of production" lines on Figures 7 and 8 indicates the per-acre returns from irrigated and dryland grain sorghum at 1954 and 1955 prices for grain. The price reduction of 50 cents per hundredweight in 1955 removed most of the profit from sorghum production, Figure 7.

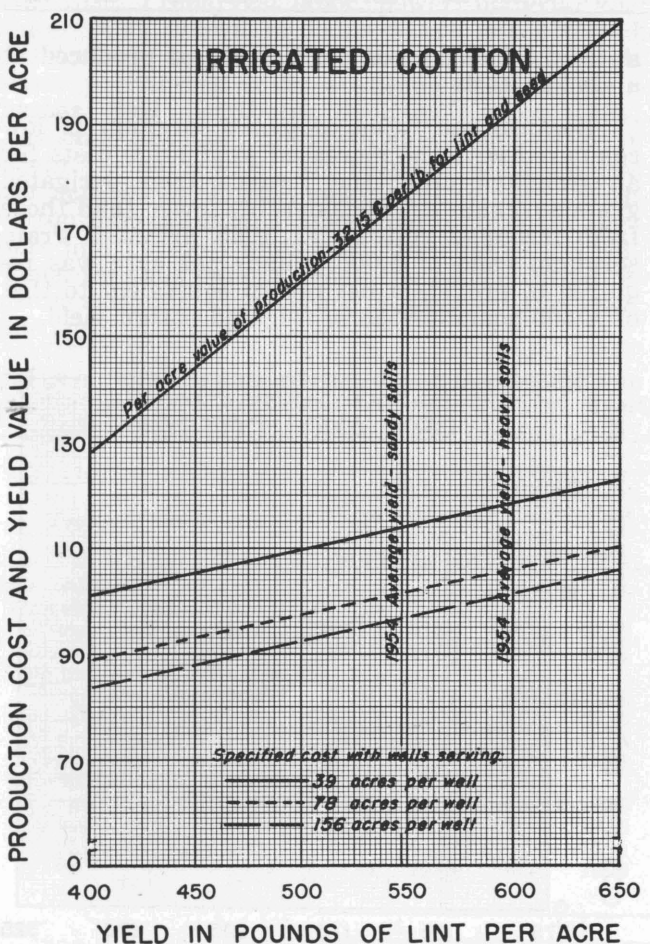


Figure 3. Specified production cost (power and machinery, labor, materials, water and harvesting cost) and value of production per acre, irrigated cotton, related to yield per acre and to acres irrigated per well. Average cost on 160 and 320-acre sandy and heavy land farms.

TENANT OPERATOR'S COST

According to the 1954 Census of Agriculture, about 50 percent of the irrigated farms on the High Plains were tenant-operated. With this proportion of the farms operated principally under some form of agreement wherein both costs and returns are shared, the tenant operator's cost merit some special consideration. Minor details of the rental agreements may differ considerably. Typically, however, the landlord provides land, buildings, well and pump, and pays well and pump repair costs. The tenant provides the pump power unit and all labor, machinery, fuel, oil, insecticide, seed and repairs required to produce and harvest the crop. The landlord receives one-third of the sorghum grain delivered to the elevator and one-fourth of the seed cotton delivered to the gin. The landlord usually pays the ginning costs on his portion of the cotton crop.

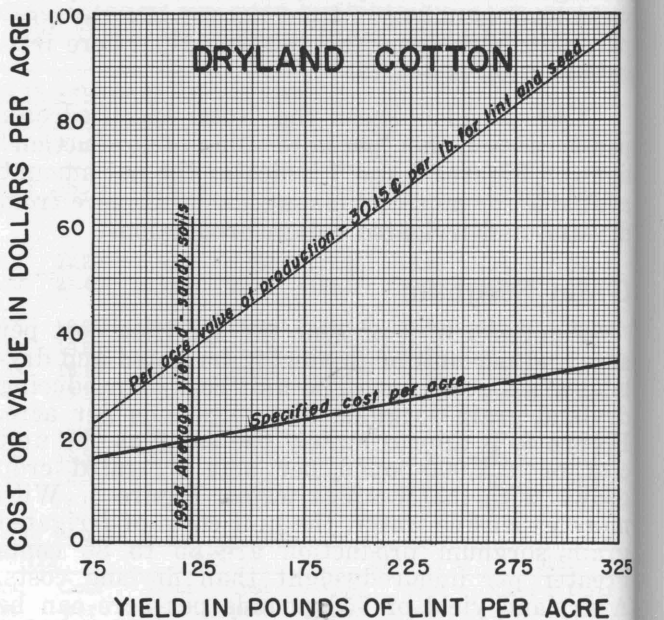


Figure 4. Specified production cost (power and machinery, labor, materials and harvesting cost) and value of production per acre, dryland cotton, related to yield per acre.

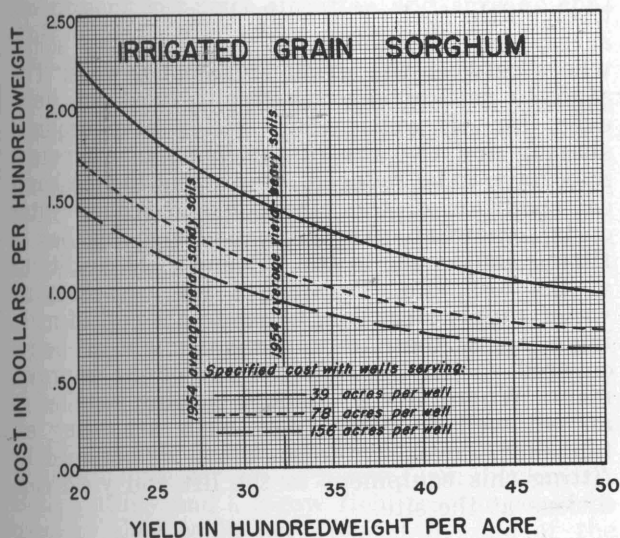


Figure 5. Specified production cost (power and machinery, labor, materials, water and harvesting cost) per hundredweight of irrigated grain sorghum related to yield per acre and acres irrigated per well. Average cost on 160 and 320-acre sandy and heavy land farms.

The tenant's specified per-acre costs and returns under the typical leasing agreement, are shown in Table 8 and in Figures 9 to 12. These cost estimates are based on the same requirements used in Tables 5 and 7. The data in Table 8 have been adjusted to reflect only the tenant's share of specified costs.

The amount of money available to cover risk, management and other unallocated costs is shown by the spread between the per-acre cost of production and the per-acre value of yield lines, Figures 9 to 12. The landlord's share of the crop, which is equivalent to the market value of the rental payment by the tenant, has been deducted from the yield value per acre so that the "value of production" lines represent the tenant's per acre total return from crop sales.

For irrigated cotton grown with the most expensive water—39 acres per well—the tenant

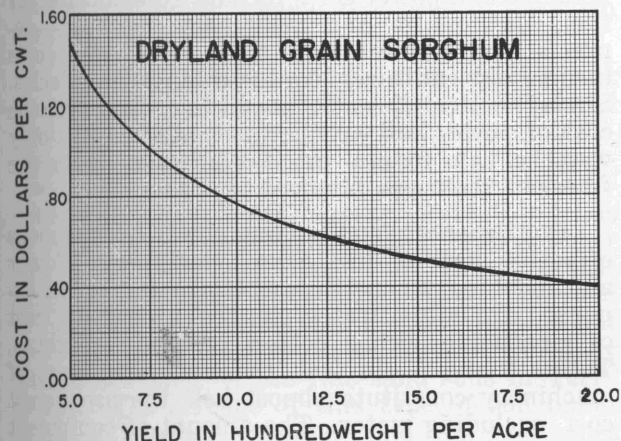


Figure 6. Specified production cost (power and machinery, labor, materials and harvesting cost) per hundredweight of dryland grain sorghum related to yield per acre.

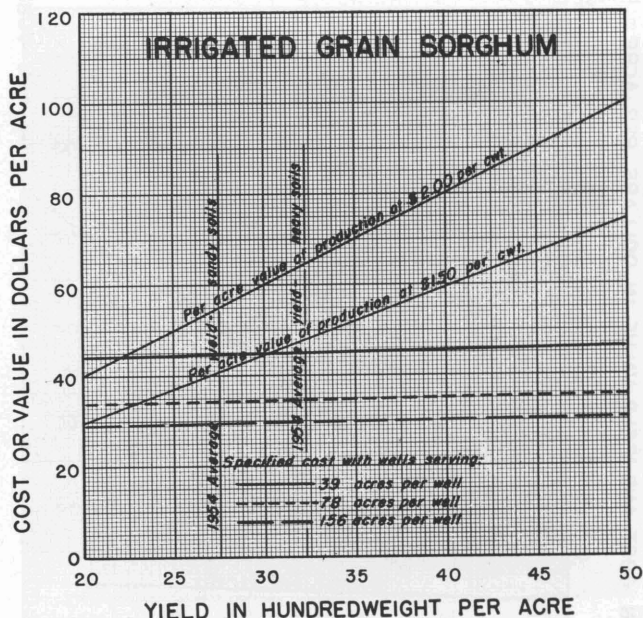


Figure 7. Specified production cost (power and machinery, labor, materials, water and harvesting cost) and value of production per acre, irrigated grain sorghum, related to yield per acre and acres irrigated per well. Average cost on 160 and 320-acre sandy and heavy land farms.

must produce 420 pounds of lint per acre to earn the equivalent of wages for his efforts, Figure 9. At the 400-pound level, he recovers his cash and overhead costs and \$2.44 per acre for his labor: 39 cents per hour compared with a 1955 wage rate of 95 cents per hour. With 1954 average cotton yields on sandy soils, a tenant who uses water from a well serving 39 acres has a management income of \$17.22 per acre.

At 1955 prices, average or better-than-average yields of irrigated grain sorghum are required to pay rent, labor, production, overhead and prime costs, Figure 10.

The situation is much the same with dryland cotton and grain sorghum production, Figures 11 and 12. A comparison of cost and returns in Figures 4 and 8 with those in Figures 11 and 12 shows that although the tenant recovers his specified cost at the lower yield, he receives a very low price for his labor.

POSSIBLE COST REDUCTIONS

Water constitutes one of the largest items of expense in preharvest costs, but substantial reductions in water cost seem unlikely. One prospect is to reduce fuel costs by a shift to natural gas. Natural gas lines cost about \$1,000 per well; consequently, the shift is advisable only if the annual fuel requirements are large. For large wells, a shift to natural gas would reduce annual costs of fuel substantially, and the savings would be sufficient to amortize the cost of the gas line.

For small wells, the shift is inadvisable since the engines that power small wells require rela-

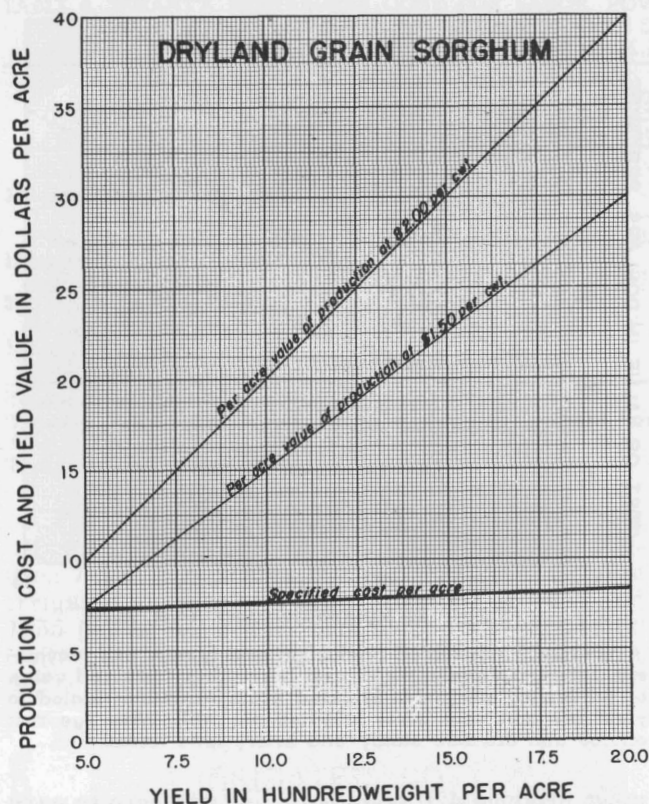


Figure 8. Specified production cost (power and machinery, labor, materials and harvesting cost) and value of production per acre, dryland grain sorghum, related to yield per acre.

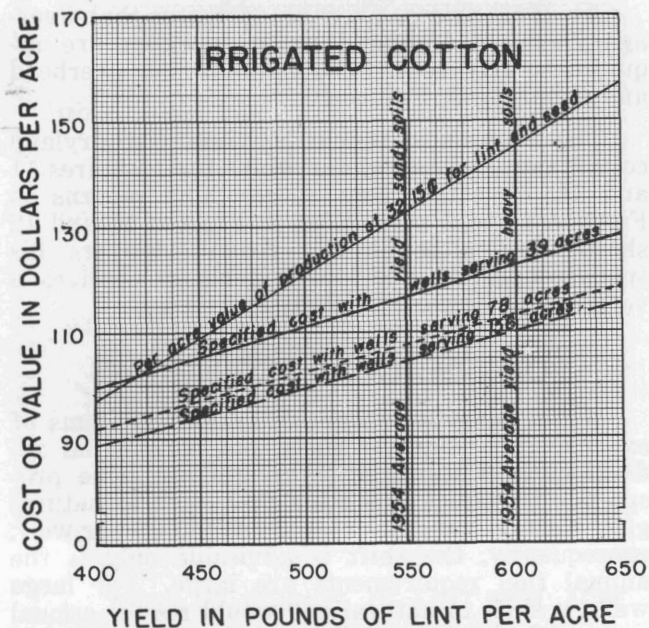


Figure 9. Tenant's specified costs and returns from irrigated cotton production under typical crop-share rental contract related to yield per acre and acres irrigated per well. Average costs on 160 and 320-acre sandy and heavy land farms.

tively little fuel. For wells that serve 39 to 78 acres, the advisability of the shift lies somewhere between the larger and smaller wells. The shift to natural gas is virtually ruled out, however, for all wells where yields have declined sharply and the size of the pumping equipment may have to be reduced. Improving the mechanical condition of the pumps would reduce water costs somewhat. Another possible saving lies in fitting equipment to the lift and yield conditions at the well site. Because of the ever-changing water supply situation, however, the cost of making either of these improvements might not be recovered within the effective life of the improvement. Where new equipment is being installed in an old well or where new wells are being established, lower water costs can be obtained by fitting this equipment to the lift and yield conditions at the site.

Irrigation research and general experience show that higher rates of water application will increase crop yields. However, the regional decline in water levels indicates that the water resources will not support even the present rate of water use. Relief through increased water use therefore, would be at the expense of production in future years.

Another possibility for reducing the costs of crop production on irrigated farms on the High Plains lies in the mechanization of the cotton harvest. Farm operations in this area are conducted on medium-size to large, highly mechanized farms; consequently, most of the savings from mechanized, large-scale farm operations have been realized already. The one notable exception on irrigated farms is cotton harvesting. Most of the cotton still is hand-snapped.

The proportion of specified costs attributable to preharvest operations is shown in Table 5 as labor, power and machinery, materials and water costs. Under the system now followed on the High Plains, a reduction in wage rates would not necessarily add to profits since the farm operator supplies most of the preharvest labor himself. Machine and power costs include expenditures for fuel, oil, repairs and machinery overhead—depreciation, interest and taxes. Material costs include expenditures for seed and insecticides. Since the farm operator has little control over the cost of power and production materials, the only way he can reduce preharvest costs is to use fewer of the items involved.

One prospect for reducing power costs is more effective use of less farm machinery. Power and machinery constitute the largest item of expense, excluding water, in the preharvest cost of producing either cotton or grain sorghum, Tables 3 and 5. In fact, the ownership costs of machinery constitute almost half the preharvest cost, excluding water. The amount of equipment now used meets satisfactorily the physical requirements of producing crops under the weather conditions of the High Plains. However, under

the present cost-price situation and acreage controls, a lower investment in machinery may be required to reduce costs.

Prospects for reducing machinery costs are much greater on the 320-acre irrigated farm, where three tractors commonly are used, than on the 160-acre farm equipped with one field and one utility tractor. Reducing the number of tractors to two on 320-acre farms may alter the timeliness of operation, but the prospects of a reduction in yield because of a delay of 1 or 2 days in most critical farm operations appears to be remote. Eliminating one 4-row field tractor and its attachments would reduce the annual cost of owning farm machinery by \$750.

On 160-acre farms, machinery costs could be reduced by greater use of 2-row farm machinery. Both a utility and a 2-row field tractor could be used, or they could be replaced by one of the larger 2-row utility tractors with the newly adopted fast-hitch equipment. The use of 2-row equipment would increase the hours of labor required to perform those operations that are now performed with 4-row machinery. Possible savings through a fuller use of 2-row equipment and a reduction in the machinery investment per farm should be balanced against the increase in labor requirements.

A return to less intensive cultural practices offers another prospect for reducing costs. Cotton yields obtained on some of the partly irrigated farms, where the intensity of cultural practices is similar to those applied on dryland, suggests that some practices adopted in recent years may be eliminated or reduced in frequency. For example, "flat breaking" and "deep plowing" increases the labor and power requirements substantially for irrigated crops, but they are seldom practiced on the partly irrigated farm. A return to the less intensive cultural practices followed in the late 1940's probably would not reduce yields greatly. It would, however, eliminate a substantial amount of the labor and power required to produce irrigated crops. It also would facilitate the use of fewer and perhaps smaller tractors, with a consequent reduction in the farm machinery investment.

Increasing per-acre yields is the most direct way to lower unit production costs, but several conditions on the High Plains limit the possibilities of this method. The length of the frost-free growing season restricts cotton yields compared with yields in other areas. Fertilizer trials at the Lubbock Experiment Station (sandy land) and at the Ewen farm near Tulia (heavy land), reveal no significant difference between the yield of fertilized and unfertilized cotton.⁸ Significant yield increases, however, have been obtained by fertilizing cotton on the fine sand soils in Terry county. The acreage of this type of soil under irrigation is relatively minor, and this study does not include production requirements and costs on soils of this nature.

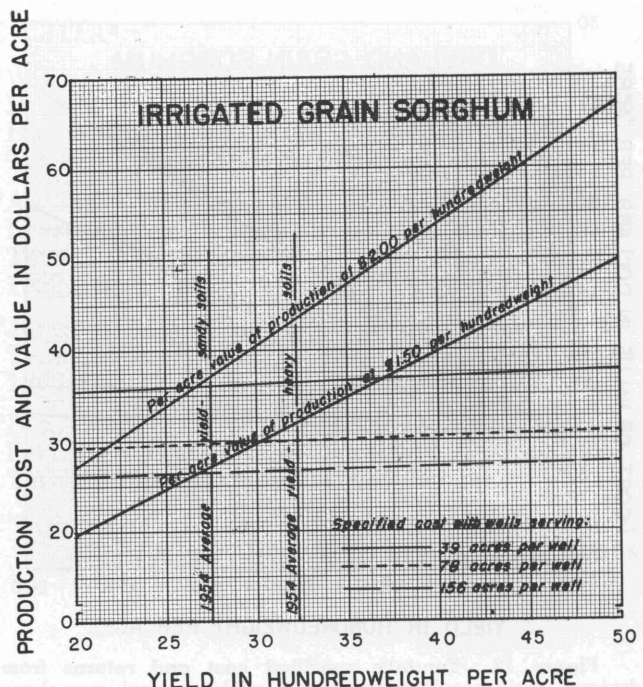


Figure 10. Tenant's specified costs and returns from irrigated grain sorghum production under typical crop-share rental contract related to yield per acre and acres irrigated per well. Average cost on 160 and 320-acre sandy and heavy land farms.

Tests at Lubbock and Tulia show that fertilizer will increase the yield of irrigated grain sorghum significantly, provided the land was heavily cropped (5,000 pounds per acre) the preceding season.¹⁰ Tests also indicate that "the use of nitrogen when sufficient water is not available during the growing season may be unprofitable."¹⁰

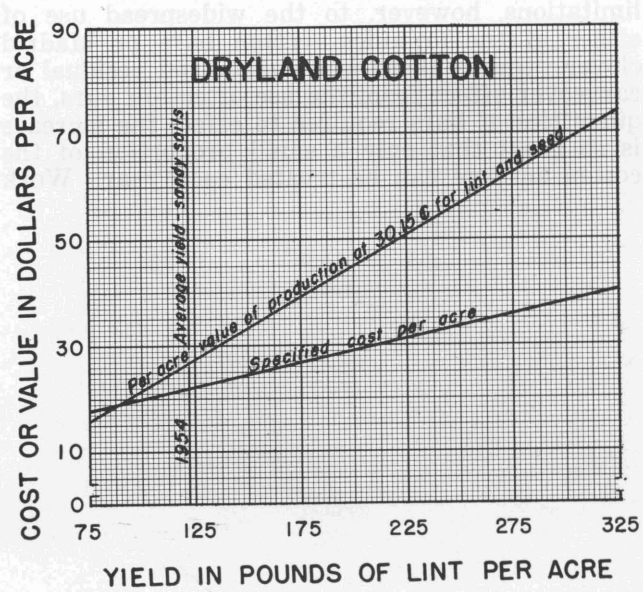


Figure 11. Tenant's specified costs and returns from dryland cotton production under typical crop-share rental contract related to yield per acre.

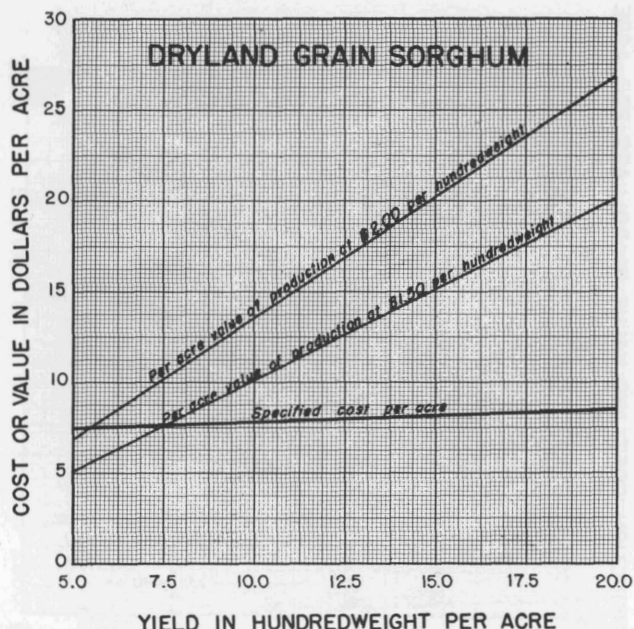


Figure 12. Tenant's specified cost and returns from dryland grain sorghum production under typical crop-share rental contract related to yield per acre.

Although inorganic fertilizers have not proved beneficial on the "sandy" and "heavy" land areas included in this study, some significant increases in cotton yields have been obtained through the use of organic materials. Annual application of 2 tons of cotton burs during a 3-year period increased cotton yields approximately 20 percent. A slightly larger increase was obtained through the use of Madrid clover in a sorghum-clover-cotton rotation.⁸

Research to date indicates that organic, rather than inorganic materials, affords the best prospect for increasing yields. There are several limitations, however, to the widespread use of either of the organics—cotton burs or Madrid clover. Unless there is a substantial residual or carryover effect from the use of cotton burs, the quantities of burs required to effect the increase is so great that only a small proportion of the cotton acreage can be treated each year. Work

to determine the residual effects of cotton bur application is now underway at the Lubbock station.

The use of Madrid clover, or other cover crops as a green manure crop, entails considerable additional expense and the use of 6 to 9 inches of additional water. Unless an operator has a well of better-than-average capacity, the water demands of the cover crop will prevent or curtail the amount of preseasonal irrigation.

The quantities of burs required and possible conflict in demands for water may limit sharply the widespread use of organic materials. For the individual, however, who has access to a sufficient quantity of cotton burs, or who has a well of sufficient capacity to meet the water demands of a cover crop and preseasonal irrigation at the same time, organic materials provide an opportunity for increasing cotton yield.

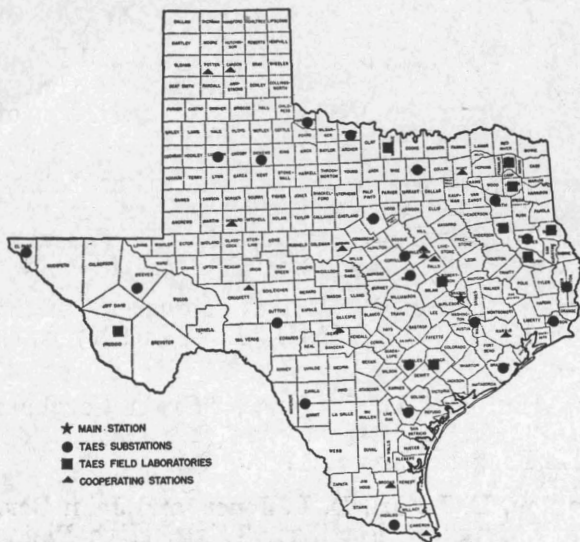
In certain situations, the adoption of contour or short, level furrow irrigation practice will reduce the irrigation requirements. Adoption of these practices does not necessarily reduce production costs since possible savings in water cost or gains resulting from more efficient water use will be offset, at least in part, by the added costs involved. Generally, the prospects of reducing either the per-acre or per-unit production cost through these methods depends, as with the use of organic materials, on conditions on the individual farm.

Use of the newly developed grain sorghum hybrids may lower the unit cost for sorghum, but would not necessarily improve its competitive position with cotton. The increased production resulting from widespread adoption of sorghum hybrids could depress prices still more.

Of the three costs that might be lowered—harvesting, preharvest and unit—only mechanization of the cotton harvest provides an opportunity for substantially lower production costs. Somewhat lower preharvest costs can be obtained by using less farm machinery and by using fewer practices that require a large amount of time and power.

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Location of field research units in Texas maintained by the Texas Agricultural Experiment Station and cooperating agencies

State-wide Research



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RESearch BY THE TEXAS STATION is organized by programs and projects. A program of research represents a coordinated effort to solve the many problems relating to a common objective or situation. A research project represents the procedures for attacking a specific problem within a program.

THE TEXAS STATION is conducting about 350 active research projects, grouped in 25 programs which include all phases of agriculture in Texas. Among these are: conservation and improvement of soils; conservation and use of water in agriculture; grasses and legumes for pastures, ranges, hay, conservation and improvement of soils; grain crops; cotton and other fiber crops; vegetable crops; citrus and other subtropical fruits, fruits and nuts; oil seed crops—other than cotton; ornamental plants—including turf; brush and weeds; insects; plant diseases; beef cattle; dairy cattle; sheep and goats; swine; chickens and turkeys; animal disease and parasites; fish and game on farms and ranches; farm and ranch engineering; farm and ranch business; marketing agricultural products; rural home economics; and rural agricultural economics. Two additional programs are maintenance and upkeep, and central services.

RESearch RESULTS are carried to Texas farm and ranch owners and homemakers by specialists and county agents of the Texas Agricultural Extension Service.